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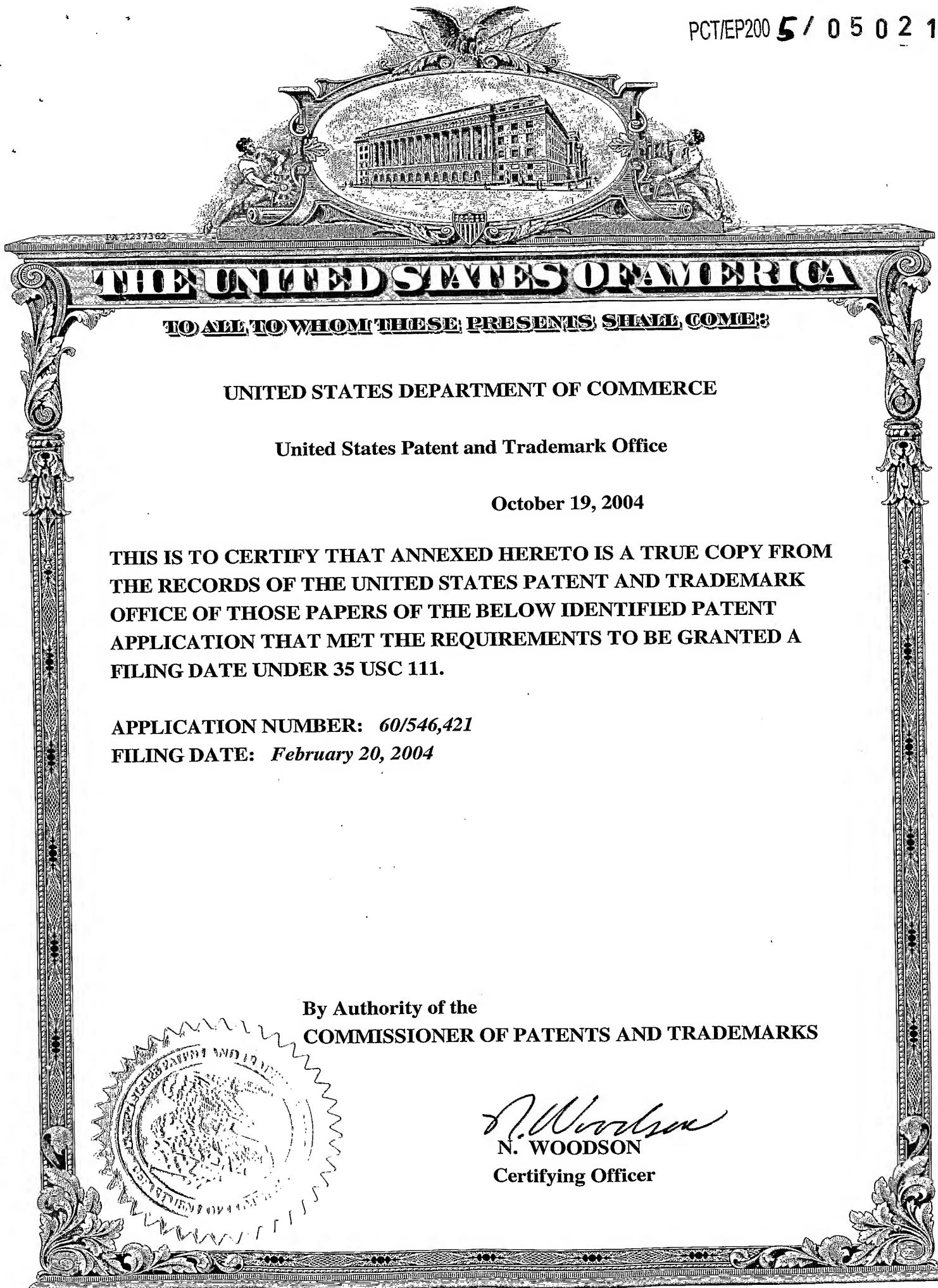
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

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Sir:

This is a request for a Provisional Application for Patent under
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TITLE: TDM Emulated IP-Call

This provisional application includes:

- 21 pages: specification, sheets of drawings, flowchart
— photographs (design patent application only)

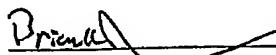
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PROVISIONAL PATENT APPLICATION

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TITLE OF INVENTION:

TDM Emulated IP-Call

**TDM emulated
IP-call**

Problem

TDM network has evolved and enriched itself by innumerable features in the last decades, while the IP network is growing with astonishing speed. Each of these networks has its merits. TDM is very reliable and feature-rich with quality of service, while IP offers multimedia, more flexibility and POP for its end points. There is a growing wish, both in the business sector as well as in consumer segment for IP application. However, this wish cannot be fulfilled without interoperability of the two networks. The marriage of the two networks is enforced by the fact, that the major number of subscribers exists in the TDM. Any IP-subscriber calling a TDM subscriber has to go inevitably through a GW. One should remember that TDM networks are mature network consisting of highly invested and very costly evolved elements that cannot be simply put aside!

There have been various efforts in telecom industry to address this issue, and many solutions have emerged, but most solutions sacrifice one-or-more aspects of one to get the other in contrast to marriage that combines the virtues of both parties. As long as IP network has not gone through similar evolution, it should fill the gap by utilizing the TDM network.

Let us review briefly the mechanisms and characteristics of the two networks namely TDM , IP and their corresponding switches (TDM switch and softswitch).

In a TDM switch:

- T0- a switch represent a SS7 node
- T1- In a TDM switch, calls are initiated by dialing digits only
- T2- The switch routes the call by the dialed digits.
- T3- The data needed for routing can reside entirely or at least partially in the switch, therefore a database is needed.
- T4-Subscriber database is needed for
- T5-Subscriber validation and
- T6-Feature subscription validation
- T7-Additionally feature handling functionality should be provided in the switch
- T8-The concept of redundancy in TDM does not cover the case of network failure
- T9-TDM resources are seized for a given call for the entire lifetime of the call

In a softswitch:

- S0-a softswitch still has to introduce a SS7 node
- S1- in additional to point 1 above, a softswitch can initiate a call also by name-dialing
- S2- to S8, are same as T2 to T8
- S9- there is no resources required for the bearer in contrast to TDM (point 9 above).
- S10-a softswitch offers IP endpoints
- S11-a softswitch has its own feature fabric and no softswitch can currently offer the vast range of TDM features.
- TS12-The interworking of these two networks necessitates a mediation called gateway.

Having mentioned these points, the problem handled in this paper is as follow:

How could a network entity be introduced which

- 0- 0-does not require a new SS7 node
- 1- 1-support digit and name dialing
- 2- use external routing service
- 3- has minimal routing database
- 4- has minimal subscriber database
- 5- minimal subscriber validation
- 6- minimal/no feature subscription validation
- 7- minimal feature-handling recreation
- 8- introduce a network failure tolerant redundancy
- 9- optimize the resource usage
- 10-offer IP-endpoints as well as TDM endpoints
- 11-use external feature fabric
- 12-12-facilitate TDM-endpoint-IP-endpoint interwork as well as TDM-network-IP-network interworking (shall be described more detailed in solution)

Solution

As indicated above, the network entities such as a TDM switch, or softswitch, or an integrated packet card, fulfill some of the tasks mentioned above under T0 to T12 or S0 to S12. whereas there is no network entity known to fulfill all the above 0 to 12 criteria.

As a summary the solution presented in this paper fulfils following criteria:

- a) Keep the TDM switch
- b) Do not impact the TDM switch
- c) Do not introduce a new node
- d) Offer IP-endpoints on the TDM switch
- e) Offer other endpoint types (e.g POTS, ISDN ..)
- f) Use TDM routing fabric
- g) Utilize TDM administration
- h) Use minimal TDM resources for introduced IP-endpoints
- i) Utilize the feature fabric capability of the TDM switch for introduced IP-endpoints
- j) IP-features may be added internally or externally such as name dialing
- k) Provide scalability for usage of the media (TDM/IP)
- l) Be generic in the sense of being independent from TDM-switch vendor
- m) Be generic in the sense of lata-independent in the sense of interoperability, the solution should be independent of where the solution is applied.
- n) Facilitate gateway functionality between TDM-endpoint and IP-endpoint
- o) Facilitate gateway functionality between TDM-network (TDM switch) and IP-network (softswitch).

Feasibility

The following figure depicts suggested network configuration:

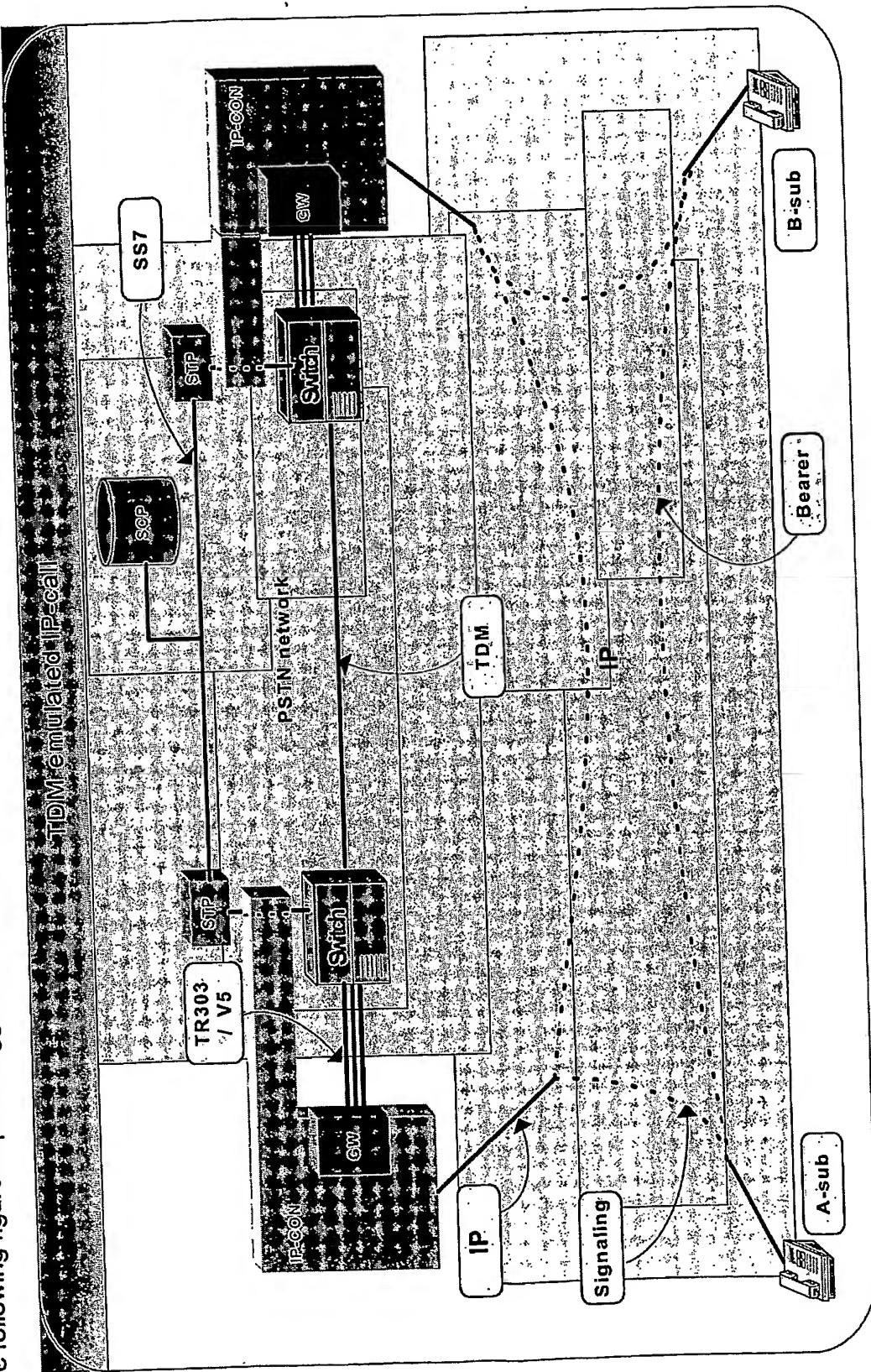


Figure 1
4

IPCON is the new introduced element to the TDM network. From the viewpoint of TDM-switch, IP-CON, as a physical entity, acts as a subscriber concentrator (IP-CONcentrator). But from the viewpoint of IP-network, IP-CON is a call agent for the IP-subscribers.

Basic call:

The figure 1 assumes that the calling and the called are both IP-end points. At the first glance, the figure resembles the common IP to TDM-TDM to IP call, seizing both IP and TDM resources for a single call. From the standpoint of the solution presented in this paper, the TDM path is needless and wasteful. What is not shown in the figure above is the following:

- 1- The A-IP-CON receives the call request from it's IP- subscriber, and forwards a corresponding setup to the TDM-switch (via GR303 / V5).
- 2- The subscriber is authenticated by IPCON for it's IP nature. The subscriber is further validated by TDM-Switch for its subscription.
- 3- The call is authenticated by TDM network.
- 4- The routing functionality of the TDM is utilized to select the facility
- 5- The TDM facilities are seized through the TDM network to the terminating office
- 6- The terminating office is invoked to present the call to B-IP-CON
- 7- A bearer-channel is seized and TDM path between the involved A and B-IP-CONs is setup.
- 8- The A-IP-CON and B-IP-CON use the provided TDM path to exchange signals with each other. There are three methods to realize this signaling (explained later)
- 9- Having collected necessary information (IP address and etc) the involved IP-CONs attempt to setup an IP-connection. Once the IP-connection between A and B-IPCON is setup, the IP-CONs negotiate the bearer path through IP-network. After the bearer path is established, the IP-CONs can drop the TDM call so that the combinational path IP-TDM-TDM-IP from now on can be collapsed into one single IP path.

With reference to point 8) above, the IP-CONs have following possibilities to exchange signals:

- a- ISDN configuration:
A-IP-CON can send UU-info at the time of setup request (point 1), which is forwarded all the way to B-IPCON. Thus, the B-IP-CON detects the IP nature of the originator. B-IPCON can initiate an IP-connection backward to the A-IPCON using the information collected from UU-info.
- b- ISDN or Analog configuration:
The TDM-call presentation to B-IPCON includes the necessary information about A-IPCON using calling name delivery. Thus the B-IPCON detects the IP-nature of the origination. The B-IPCON can initiate a backward IP-connection to A-IPCON.
- c- ISDN or Analog configuration:
After the TDM-call is answered, the bearer path is both way established, hence both IP-CONs can exchange information inband. Any one of the IP-CONs can be chosen to initiate the IP-connection.

A combination of above three methods may guaranty interoperability between different implementations of IP-CON.

That is the suggested basic call for an IP-endpoint calling another IP-endpoint with seizing the TDM resources only for the purpose of utilizing the TDM routing and signaling.

Obviously, if one of the involved parties is purely TDM, then the TDM connection cannot be dropped. Moreover, it is essential to point out that if the information in the a-to c- could not be interpreted by the involved A and B-side call agents, then the connection will remain as a TDM, regardless of the nature of the subscribers.

With regards to point 9) above, it is important to point out, dropping the TDM path and collapsing the paths (IP-TDM-TDM-IP) into one path (purely IP), can be performed in a dynamic scalable manner. The flexibility of the method described above is best seen by the following facts:

- After the two paths, IP and TDM, are established, the IPCONs can decide to drop any one of them or reestablish any one of them at any given time in call. This can be used as a unique feature to empower a connection to become fault tolerant.
- The choice given by this solution to realize a connection on any one of the two networks (TDM or IP), offers a great deal of flexibility to control dynamically the load distribution. This solution is in particular beneficial for network congestion control.

From viewpoint of TDM switch, the IPCON is a GR303/V5 concentrator, and all IP-subscribers behind the IPCON appear as regular subscriber to TDM switch, therefore the administration of these IP-subscribers can be incorporated into the TDM-switch without any impact.

Since the IPCON initiates every call through the TDM switch, therefore the TDM-feature fabric can be fully utilized.

Figure 2 below shows the IP to IP call, with IPCONs acting as call agents.

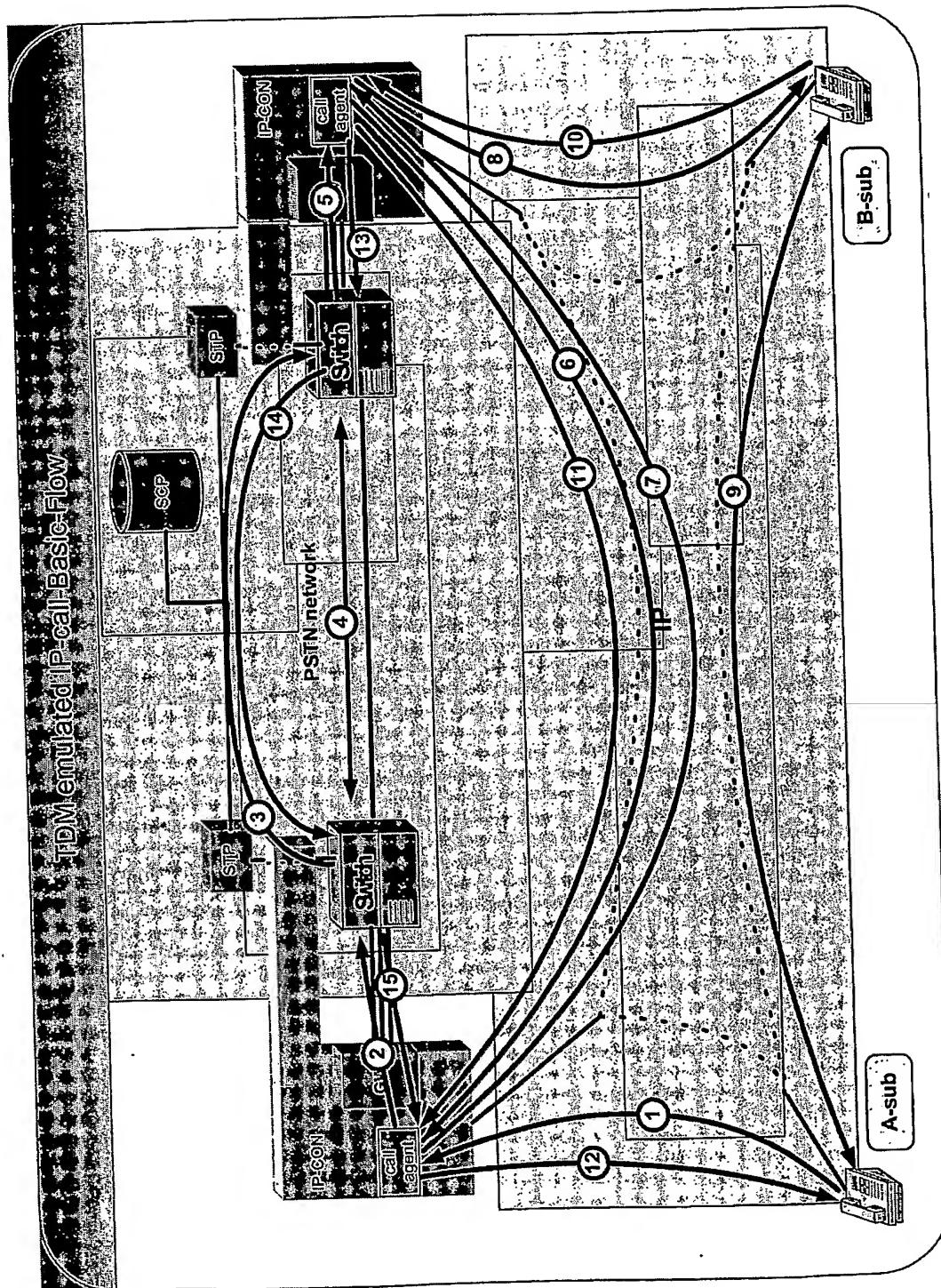


Figure 2

description:

- 1 = IP: call request
- 2 = TDM:SETUP (UU-INFO= A-IPCON ID, CALL ID)
- 3 = SS7: IAM
- 4 = TDM:BEARER_PATH SETUP
- 5 = TDM:SETUP(UU-INFO= A-IPCON ID, CALL ID)
- 6 = IP: REINVITE (CALL ID, B-IPCON ID)
- 7 = IP: HANDSHAKE
- 8 = IP: call request
- 9 = IP:BEARER PATH SETUP
- 10= IP: CONNECT
- 11= IP: CONNECT
- 12= IP: CONNECT
- 13= TDM: RELEASE
- 14= SS7:REL
- 15= TDM: RELEASE

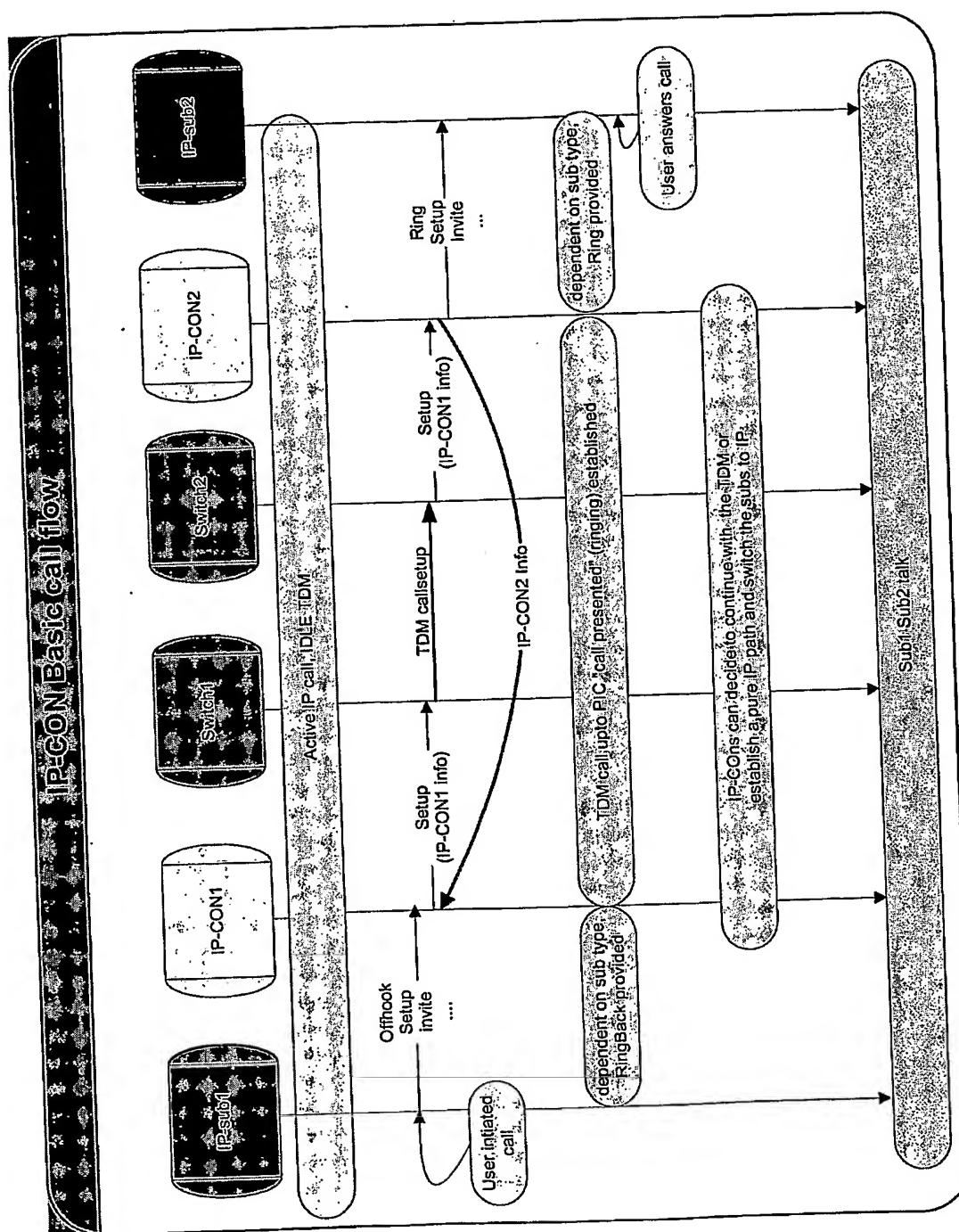


Figure 3

Interworking

Interworking between TDM-switch and softswitch:

Basic call:

The figure 4 assumes that the calling resides on a TDM switch connected via an IP-CON. The calling subscriber maybe of any type. The called party is residing on a softswitch. The B-IP-CON contains the trunk of TDM network to softswitch.

Usually the configuration assumes that the B-IP-CON maintains its gateway functionality through out the call to mediate the TDM bearer path to IP. This is not always true, because if the A-subscriber is connected via an IP-CON (A_IP-CON in figure 4), then the B-IP-CON can pass the gateway functionality to the A-IP-CON.

following:

- 1- The A-IP-CON receives the call request from it's subscriber, and forwards a corresponding setup to the TDM-switch (via GR303 / V5).
- 2- The subscriber is authenticated by IPCON for it's IP nature. The subscriber is further validated by TDM-Switch for its subscription if A-side is an IP-subscriber.
- 3- The call is authenticated by TDM network.
- 4- The routing functionality of the TDM is utilized to select the facility
- 5- The TDM facilities are seized through the TDM network to the terminating office
- 6- The terminating office is invoked to present the call to B-IPCON
- 7- A bearer-channel is seized and TDM path between the involved A and B-IP-CONs is setup.
- 8- The A-IP-CON and B-IP-CON use the provided TDM path to exchange signals with each other. There are three methods to realize this signaling (explained before)
- 9- Having collected necessary information (IP address and etc) the involved IP-CONs attempt to setup an IP-connection.
- 10-The B-IP-CON establishes signaling to the softswitch (IP-wise)
- 11-The B-IP-CON is the call agent for outgoing trunk to the softswitch, therefore it negotiates the bearer with the softswitch for this call and signals the bearer information to A-IP-CON
- 12-The B-IP-CON initiates the redirection of the bearer-path
- 13-The TDM path (signaling and bearer) can now be dropped and TDM resources can be released.

POTS subscriber directly connected to the TDM switch, calling a subscriber on the softswitch, the B-IP-CON remains in the call path as a gateway and trunking throughout the call.

The interworking between IP-CONs of a TDM switch and softswitch-subscriber is depicted in the following figure:

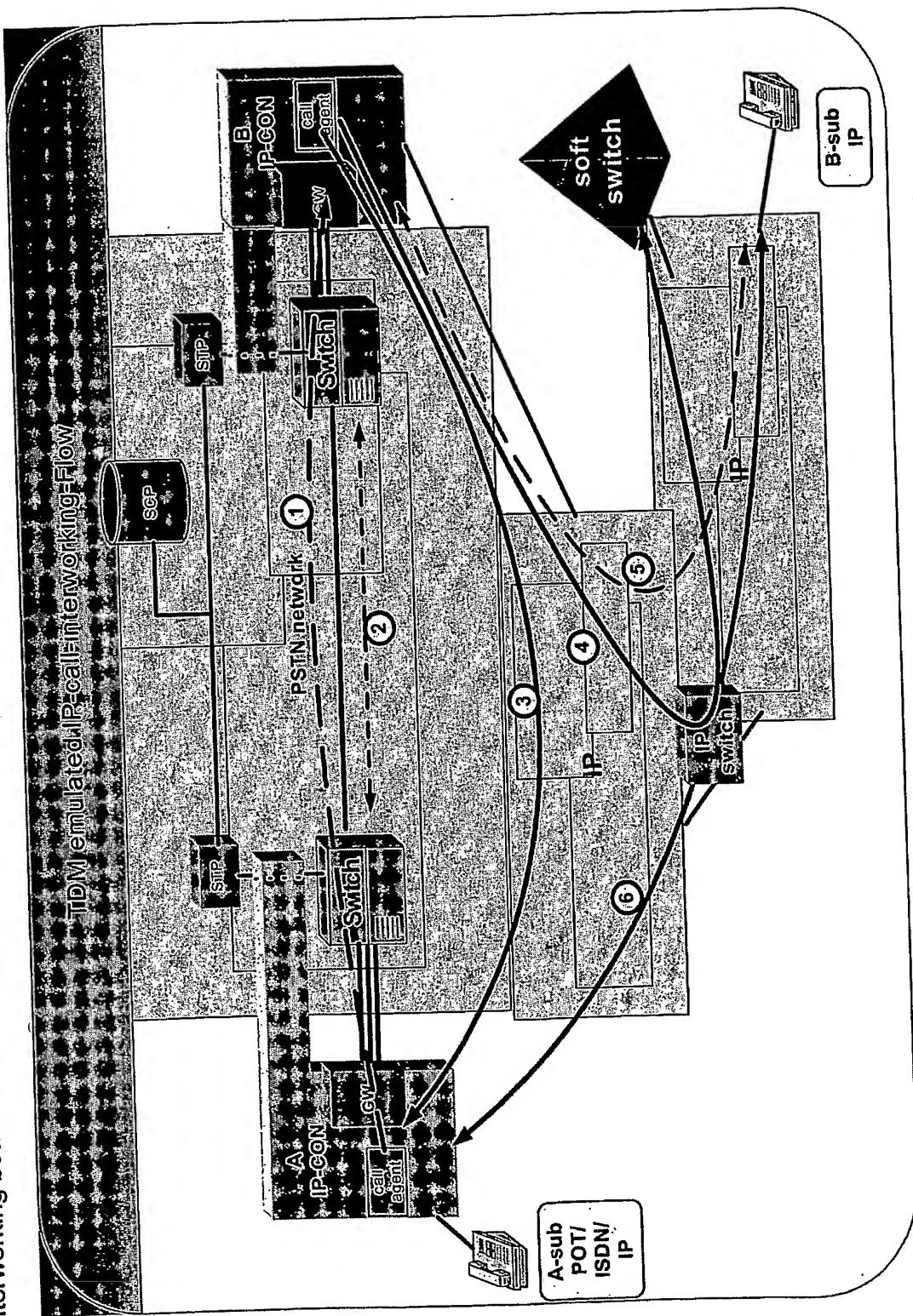


Figure 4

As shown in above figure, an IP-CON subscriber may call a subscriber of a softswitch (may reside in other network). The call flow description is:

1 = IP: call request

TDM:SETUP (UU-INFO= A-IPCON ID, CALL ID)

SS7: IAM

TDM:SETUP(UU-INFO= A-IPCON ID, CALL ID)

2 = TDM:BEARER_PATH SETUP

3 = IP: REINVITE (CALL ID, B-IPCON ID)

IP: HANDSHAKE

4 = IP: call request

5 = IP:BEARER PATH SETUP

6 = BEARER REDIRECT

Once this point is reached, then the TDM signaling (path 1) and Beraer path (2 and 5) can be dropped.

In this scenario, if the A-subscriber on IP-CON is an IP type, then the final bearer path shall be pure IP, otherwise for other types of subscriber (such as POTS or ISDN) the A-IP-CON shall perform gateway functionality for his subscriber.

As seen in above figure, the connection between TDM network and IP-network of the softswitch is realized by a trunk residing on B-IP-CON.

A new Network

A new network of IP-CONs can be envisioned by looking upon the TDM and IP networks merely as resources and facilities utilized by IP-CONs. Once this view is selected, then the two networks (IP and TDM) can hide behind the IP-CON cloud. This can create a new class of providers, who utilize the TDM and IP network as service users, and offer :

-IP-endpoint(subscriber/trunk)

-POTS

-ISDN (subscriber/trunk)

via IP-CONs.

This point is what was referred to as lata-independent interoperability of the solution.

Such new providers use TDM switch for signalling and routing (optionally feature fabric) and IP as signalling and bearer media.

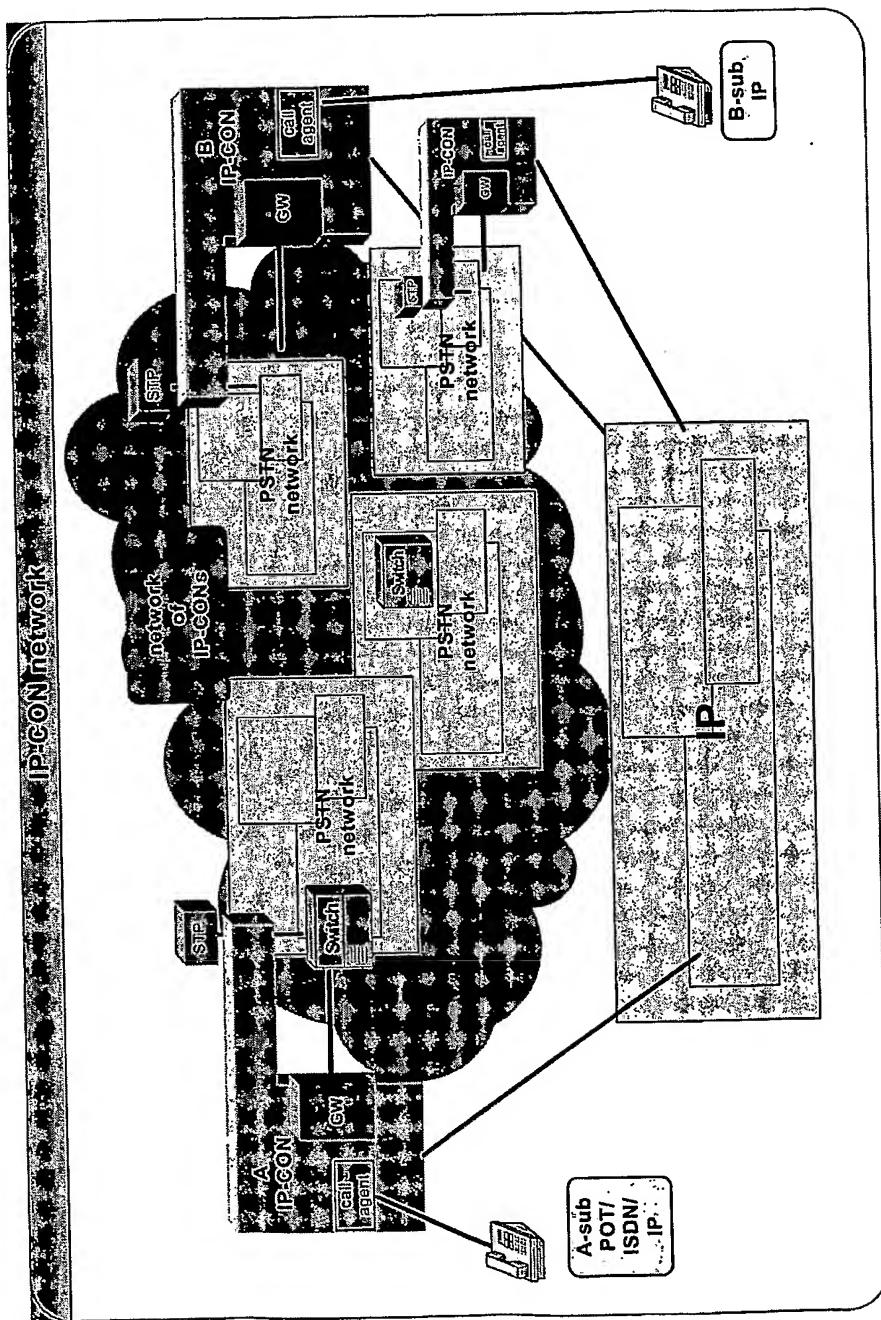


Figure 5

The options are open for IP-CONs to perform their subscriber administration and authentication.

Connection types

Following connection types can be supported by IP-CON:

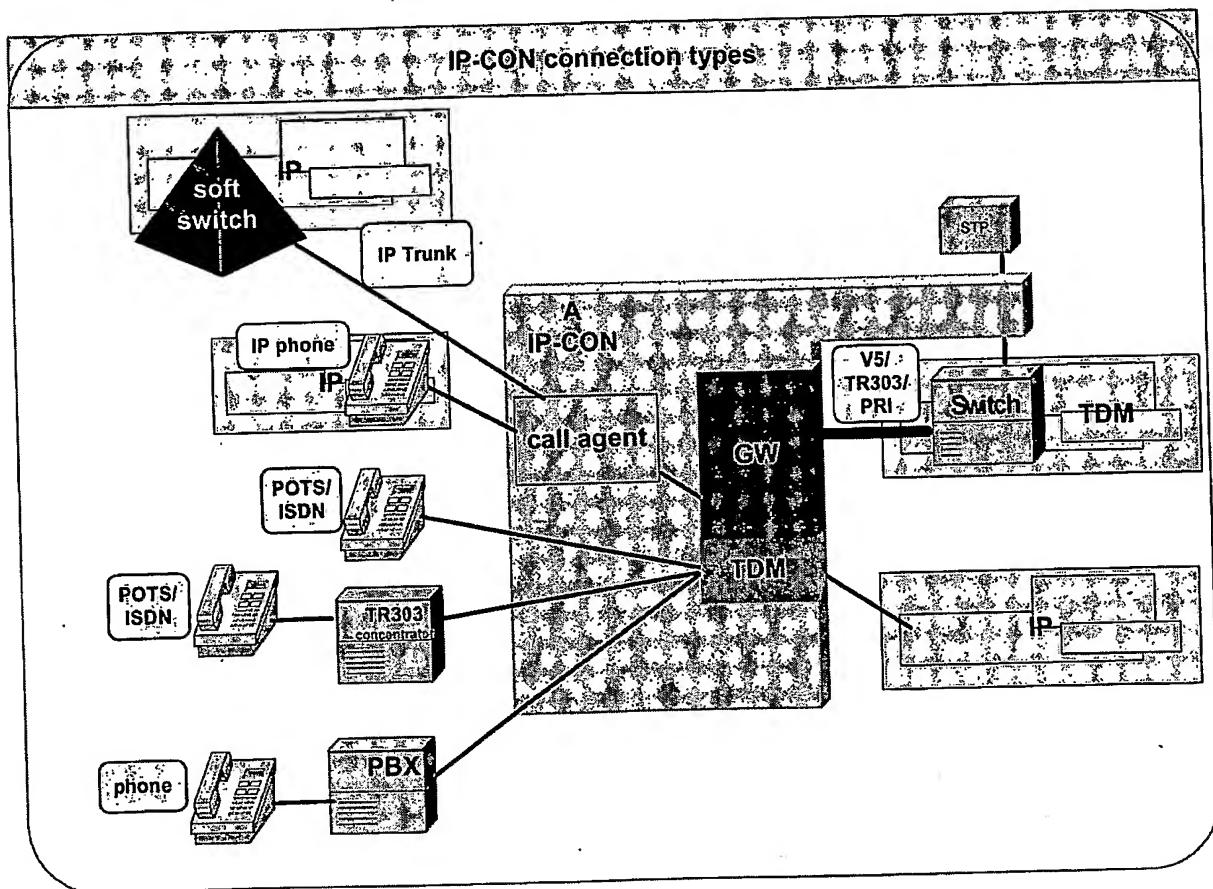


Figure 6

Scalability

Scalability is one of the unique properties of IP-CON. Since the IP-CON can toggle between the TDM and IP resources for every given call, the load can be distributed between the two network resources based on factors such as time, congestion, overload protection, availability, quality and more.

An IP-CON may be connected and serve multiple TDM-switches.

Comparison

There has been many attempts to migrate the TDM and IP. Elements have been introduced into the network which either controlled by TDM switch such as integrated packet card, or gateways controlled by either softswitch or TDM switch.

The solution presented here, distinguishes itself from other solutions by the following fact:

IP-CONs, possess the intelligence to communicate and cooperate with each other. Having access to both networks, they can virtually define a superordinated network which utilizes all the virtues of the two networks (IP and TDM) in contrast to other solutions. In the following a brief comparison to throw light on the some of the novelties of this solution:

- 1- IP-CON uses standard interface such as GR303/ V5.2 or PRI to interface IP subscribers to a TDM switch
- 2- Database required on IP-CON does not need to be downloaded from switch, but like a GR303 concentrator, could be independent from switch and it is minimal
- 3- IP-CONs most important property is that the IP-CONs can talk to each other without the need of knowledge about one another. Each IP-CON learns its partner in the process of a call, i.e. in the process of a call they get to know each other. This is done by using the TDM facilities with TDM being unaware of it. This is in contrast to other introduced network elements such as integrated packet card, or gateways or IADs, that perform the slave role, where the master call agent is either the TDM or soft-switch.
- 4- If a TDM switch is involved in a call, even if the two parties of the call are IP-endpoints, the TDM resources remain fully seized for the whole lifetime of the call in all other solutions. Whereas in the solution presented here, the TDM resources are seized to the point that the two involved IP-CONs get to know each other. From that point on, the TDM resources can be freed.
- 5- Next important property is that after a given point in call, the IP-CONs involved in a call can establish an IP-call (parallel) between the two ends and hence toggle between the two calls in the two networks, and even drop the TDM call and free the TDM resources while keeping the IP-call. The same maintained IP-call can

-
- be toggled back to TDM if necessary. The necessity may arise by a network-failure, or even by the need for securing the quality.
- 6- Moreover IP-CONs use the TDM feature fabric and hence it is not needed to create their own features. This is in contrast to softswitch solution, which has to rely on its own feature fabric.
 - 7- IP-CONs use TDM routing fabric.
 - 8- The option of IP-features is also given by realizing a corresponding fabric inside the IP-CON or utilize some external IP-feature services externally.

This solution may be looked upon as a bridging solution for TDM providers to gradually introduce more IP endpoints to their network.

Formulation

This paper intends to register the following concepts for :

- 1- a method to introduce IP-subscriber in the existing TDM switch
(see above)
- 2- a set of methods for IPCONs intercommunication through the TDM network
(see above)
- 3- a method to utilize TDM routing-functionality to route IP-subscribers
(see above)
- 4- a method to utilize the TDM-switch to identify and introduce the IP-endpoints-call-agents involved in an IP-call (call agents in terms of this paper referred to as IPCON)
(see above)
- 5- Utilization of TDM-feature fabric for IP-subscribers
(see the method explained in "services for TDM emulated IP call.DOC")
- 6- **Redundancy:** a method to provide flexibility of utilizing any one of the two resources (IP/TDM) for a given IP-call and the ability to switch between the two resources during an IP-call.
(see above)

Title

**Services for
TDM emulated
IP-call**

Problem

For a subscriber of an IP-CON (subject of the submitted a concept idea "TDM emulated IP call"), the basic call is already defined in the given frameworks of that a concept idea. Such subscriber can also use some of the TDM features without any problem. However some features in TDM require the knowledge of existence of the active (ongoing) call, which may have been moved from TDM into IP by an IP-CON. This leverages complexity of feature handling.

For example, a regular call attempt to a busy pure-TDM-subscriber in TDM, shall lead to call waiting subscription verification and eventually CW handling. The same call attempt to an IP-CON subscriber, which may have an IP-call active, would not give the same result. From point of view of TDM switch this subscriber is idle. Therefore the new incoming call will not lead to call waiting subscription verification. The switch shall simply attempt to present the call to the subscriber that is believed to be idle. This is true for all B-side features.

Solution

The solution presented in this paper enables the usage of TDM-feature fabric in the new IP-CON environment with limited exceptions. There are more ways to resolve the above problem.

One of the ways to resolve the above problem is to use IN-triggers for IP-CON subscribers.

For all IP-CON subscribers, the B-side trigger Termination_Access shall be armed. The Global translation should resolve to point to the IP-CON. For an incoming call the trigger is hit, therefore the switch shall send an IN-query to the IP-CON. That means IP-CON shall be capable of performing the task of Signaling Control Point (SCP). A TCAP dialog between the switch and the IP-CON, informs the IP-CON of an incoming call for an IP-CON subscriber. TDM-switch is not aware of the real status of the an IP-CON subscriber, but the IP-CON is aware of ongoing transactions.

1-Should IP-CON find its subscriber involved in an IP-call, then IP-CON shall

- a- verify which IP-CON (own or partner) originated call
- b- inform the partner IP-CON of the need to reestablish the ongoing IP-call over TDM.
- c- the originator IP-CON reestablishes the TDM call
- d- the TDM switch is via TCAP message (CONTINUE) instructed to resume the incoming call processing

2-Should IP-CON find its subscriber idle then IP-CON shall send CONTINUE to the switch to instruct the switch to resume the incoming call processing

Another way of resolving the problem is to use call forwarding feature: when ever IP-CON establishes an IP call for one of its subscribers, IP-CON can activate Call Forwarding feature for that particular subscriber so that any incoming call for that subscriber gets forwarded to IP-CON. In this way IP-CON can decide how to proceed

with delivery of the new incoming call. Obviously this has a handicap since this method necessitates that IP-CON should have knowledge of subscriber service-subscription.

Feasibility

The following figure depicts as an example suggested call flow for call waiting:

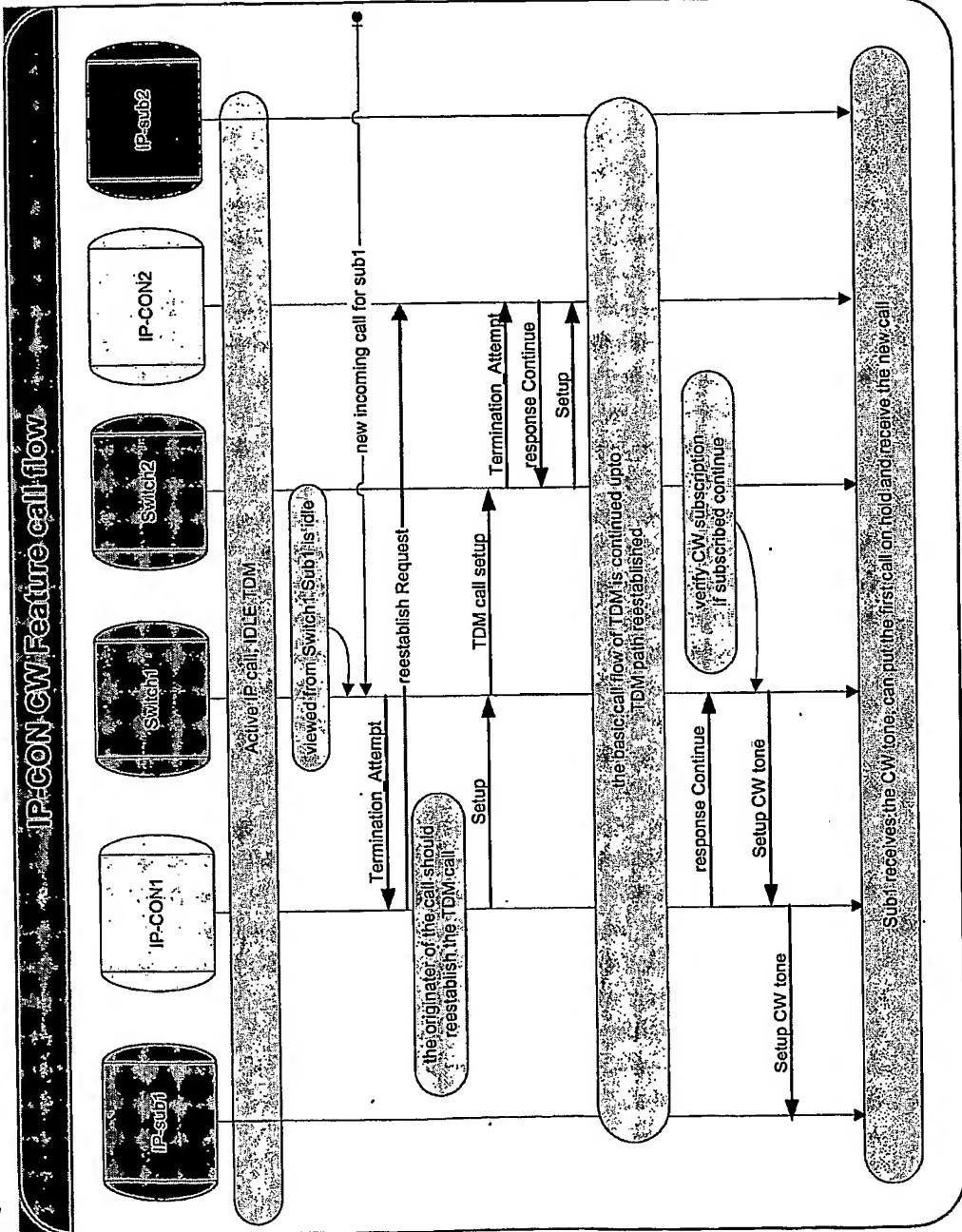


Figure 3

The method shown in the call flow above proves to be applicable to a broad range of TDM-features. An exception to these are the Intelligent Network functionalities. Since these features are being used for this method, they cannot be offered to an IP-CON subscriber.

Formulation

This paper intends to register a paper for the following concepts:

- 7- a method to utilize the TDM-feature fabric for IP-subscribers
(as shown above)